EdgeAccess

CANOGA PERKINS

# 9145ELB Network Interface Device

# Hardware User's Manual

# NOTICE

Canoga Perkins has prepared this manual for use by customers and Canoga Perkins personnel as a guide for the proper installation, operation and/or maintenance of Canoga Perkins equipment. The drawings, specifications and information contained in this document are the property of Canoga Perkins and any unauthorized use or disclosure of such drawings, specifications and information is prohibited.

Canoga Perkins reserves the right to change or update the contents of this manual and to change the specifications of its products at any time without prior notification. Every effort has been made to keep the information in this document current and accurate as of the date of publication or revision. However, no guarantee is given or implied that the document is error free or that it is accurate with regard to any specification.

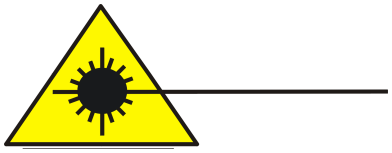
**CANOGA PERKINS CORPORATION**

20600 Prairie Street
Chatsworth, California 91311-6008
Business Phone: (818) 718-6300
(Monday through Friday 7 a.m. - 5 p.m. Pacific Time)
FAX: (818) 718-6312 (24 hrs.)
Web Site: www.canoga.com
E-mail: fiber@canoga.com

Copyright © 2012 Canoga Perkins Corporation
All Rights Reserved

EdgeAccess®
9145ELB NID Hardware User's Manual
Model Number 9145ELB
Product Number 6914100
March 2012
RevA

**EdgeAccess** and **Canoga Perkins** are registered trademarks of Canoga Perkins Corp.
To find Technical Advisories and Product Release Notes, go to the Canoga Perkins site at http://www.canoga.com.



## CAUTION!

This product may contain a laser diode emitter operating at a wavelength of 850 nm - 1610 nm. Use of optical instruments (for example: collimating optics) with this product may increase eye hazard. Use of controls or adjustments or performing procedures other than those specified herein may result in hazardous radiation exposure.

Under normal conditions, the radiation levels emitted by this product are under the Class 1 limits in 21 CFR Chapter 1, Subchapter J.

## ATTENTION!

Ce produit peut contenir un émetteur de diode de laser fonctionnant à une longueur d'onde de 850 nm - 1610 nm. Utilisation des instruments optiques (par exemple: la collimation du système optique) avec ce produit peut augmenter le danger. L'utilisation des commandes ou des ajustements ou les procédures d'exécution autre que ceux indiquées ci-dessus peut avoir comme conséquence l'exposition de la radiation dangereuse.

Dans des conditions normales, les niveaux de rayonnement émis par ce produit sont sous les limites de la classe 1 en chapitre 1, Subchapter J de 21 CFR.

## NOTICE!

This device contains static sensitive components. It should be handled only with proper electrostatic discharge (ESD) grounding procedures.

## AVIS!

Ce dispositif contient les composants sensibles statiques. Il devrait être manipulé seulement avec la Décharge Electrostatique (DES) appropriée procédures.

# General Safety Considerations

## Installation

The 9145ELB is suitable for installation in network telecommunication facilities and locations where the National Electric Code (NEC) applies.

## Restricted Access Location

Equipment must be installed in restricted access areas such as dedicated equipment room, or electrical closet, in accordance with Articles 110-18, 110-26 and 110-27 of the 1999 United States National Electrical Code ANSI/NFPA 70.

A restricted access location is a location for equipment where both of the following apply:

1. Access can only be gained by service persons or by users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and
2. Access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location.

Do not allow conductive objects to contact the circuit board and connector that are exposed when a module is removed (to prevent potential risk of heat and fire associated with high energy short circuits).

## Cabling

The 9145ELB has been designed and tested and has passed all the pertinent sections of GR-1089 and GR-63 for Type 2 and Type 4 equipment. This equipment does not have direct electrical connection to outside plant equipment.

The Copper (RJ45) ports of the 9145ELB are not intended for direct connection to "Outside Plant" metallic conductors and must be isolated (by channel banks or office repeaters) from any connections to network or terminal equipment that lie outside of the same building. The telecommunication interface connections are considered to be, and meet the requirements of, SELV circuits (not TNV).

## Power

**CAUTION:** The 9145ELB contains a field hot swapable power supply. Before servicing any power supply, its power supply core must be disconnected**.**

Wiring methods used for the connection of the equipment to the AC or DC MAINS SUPPLY must be in accordance with the National Electrical Code, ANSI/NFPA 70, and the Canadian Electrical Code, Part I, CSA C22.1.

The 9145ELB DC models meet the minimal steady state operating voltage in accordance with GR-1089, which references American National Standards Institute (ANSI) T1.315, Table 1.

| Nominal | Minimum | Maximum |
|---|---|---|
| 48 VDC | 40 VDC | 56.5 VDC |
| 24 VDC | 20 VDC | 28.3 VDC |

The 9145ELB AC and DC units do not incorporate a disconnect device. The plug on the power supply cord is intended to serve as the disconnect device. It is also recommended that the AC socket-outlet be installed near the equipment, in an easily accessible location.

The 9145ELB DC models are configured for a DC-I, Isolated DC return.

## Fuses

The 9145ELB is equipped with internal fuses. The fuse on the AC models vary by power supply manufacture 3.15A to 5A. The fuse on the DC models are 3A slow blow.

External fuse recommendation: The 48 DC models are equipped with an internal 5A slow blow fuse for the 48VDC model and 8A slow blow fuse for the 24VDC model. Although not required, an external fuse may be used to isolate the unit in a shared fuse distribution panel. Based on the 9145ELB inrush power characteristics, the minimum fuse ratings are as follows: The AC external fuse is -5A slow blow. the 48VDC external fuse is 6A slow blow. The 24VDC external fuse is 10A slow blow.

## Surge Protection

The AC powered 9145ELB does not contain an internal Surge Protective Device. An external Surge Protective Device (SPD) should be used at the AC input of the network equipment according to facilities procedures and as defined by the National Electric Code (NEC).

## Grounding

The 9145ELB AC and DC models are suitable for installation as part of the Common Bonding Network (CBN).

The 9145ELB AC and DC are provided with a safety ground connection which is capable of conducting any fault current likely to be imposed such as fault current from sources within the chassis. For the DC model, use an approved 18ga insulated wire connected to the terminal block's middle conductor.

The AC will be grounded via the ground conductor of the power cord, which must be connected to an earthed mains socket-outlet.

An electrical conducting path should exist between the 9145ELB chassis and the metal surface of the enclosure or rack in which it is mounted or to a grounding conductor. Electrical continuity should be provided by using thread-forming type mounting screws that remove any paint or nonconductive coatings and establish a metal-to-metal contact. Any paint or other nonconductive coatings should be removed on the surfaces between the mounting hardware and the enclosure or rack. The surfaces should be cleaned and an antioxidant applied before installation.

## Lightning Protection

The intra-building ports of the 9145ELB are suitable for connection to intra-building or unexposed wiring or cabling only. The intra-building port(s) of the equipment or subassembly MUST NOT be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

To protect the port against intra-building lightning surges, the RJ45 ports of 9145ELB are suitable for connection to shielded intra-building cabling grounded at both ends.

## ESD

The 9145ELB has been tested and passes the ESD requirements of Test level 4 for air and contact discharges. However to protect the exposed components from electrostatic damage when removing or replacing the small form-factor pluggable (SFP) optical modules requires the proper use of static mitigation procedures such as properly wearing a wrist strap.

## Operation Temperature

The 9145ELB is designed and Nationally Recognized Test Laboratory (NRTL) tested and verified to operate between 0℃ to 50℃, and type tested for short-term ambient temperature of minus 5℃ to 55℃.

## Fans

The 9145ELB models equipped with fans are constructed with a left to right airflow scheme. The air is drawn from the left and exhausted to the right.

Fan modules are field replaceable without powering down the chassis. The device should not be operating without a fan module installed for longer than 1 minute.

## Emissions and Immunity

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation.

The authority to operate this equipment is conditioned by the requirements that no modifications will be made to the equipment unless the changes or modifications are expressly approved by the Canoga Perkins Corporation.

**To Users of Digital Apparatus in Canada:** This Class A digital apparatus meets all requirements of the Canadian interference-causing equipment regulations.

**Aux utilisateurs des appareils numérique au Canada:** Cet appareil numérique de la classe A respecte toutes les exigences du règlement sur le matérial brouilleur du Canada.

## Special Accessories

The 9145ELB does not require any special accessories to achieve compliance for emission and immunity criteria.

### Double Pole/Neutral Fusing

On the 9145ELB a fuse may be in place in the neutral path on the AC power supply. After operation of the fuse, parts of the equipment that remain energized might represent a hazard during servicing.

## Waste Electrical and Electronic Equipment (WEEE)

### Product Disposal Information

Do not dispose of this product in unsorted municipal waste. This product is recyclable, and should be recycled according to your local standards.

For more information, contact Canoga Perkins technical support.

# Preface

## About this Manual

This manual contains information and procedures required to install, operate, troubleshoot, and maintain the 9145ELB Network Interface Device.

## How this Manual is Organized

The document includes the following chapters:

- Chapter 1, Introduction, describes the 9145ELB product, specifications, and mounting options.
- Chapter 2, Functional Description, describes the 9145ELB base unit, and provides model numbers for the base unit and Network Port modules.
- Chapter 3, Installation, provides installation procedures, mounting instructions, and rack mount kit serial numbers.
- Chapter 4, Operation, describes power-up and front panel functions, interface management, and how to set up the VT-100 terminal.
- Chapter 5, Troubleshooting, describes fault conditions and how to determine corrective action, including specific indicators for Network Port modules.
- Chapter 6, Maintenance, provides general maintenance instructions for the 9145ELB.

## Contacting Technical Support

Contact Canoga Perkins technical support (1-800-360-6642), or your 9145ELB support supplier, for hardware and software support, including product repairs and part ordering. Please have the following information available:

- NID model and serial number
- NID software version
- Detailed description of the problem and specific questions
- Details from messages in system log (if available)
- Description of any troubleshooting steps already performed and results

## Documentation Feedback

Because quality is our first concern at Canoga Perkins, we have made every effort to ensure the accuracy and completeness of this document. However, if you find an error or an omission, or you think that a topic needs further development, we want to hear from you. Forward your feedback to: techsupport@canoga.com. Provide the title and version number and as much detail as possible about your issue, including the topic heading, page number, and your suggestions for improvement.

# Contents


## Chapter 1. Introduction ..... 1

Product Description ..... 1

9145ELB Specifications ..... 1

Physical Characteristics ..... 1

Environmental Characteristics ..... 1

Power Requirements ..... 1

Regulatory Compliance ..... 2

Mounting Options ..... 2

Rack Mounting ..... 2

Terminology ..... 2

## Chapter 2. Functional Description ..... 5

9145ELB Base Unit ..... 5

9145ELB Model Numbers ..... 5

Front Panel ..... 6

User Ports ..... 7

Network Port Modules ..... 8

Dual 10G Optical Ethernet Module ..... 8

Ethernet Management Port ..... 8

Console Port and Management Interface ..... 8

Fan Module ..... 10

Powering ..... 11

AC Power Supply Module ..... 11
48 VDC Power Supply Module ..... 11
24 VDC Power Supply Module ..... 12
Reset Button ..... 12

**Chapter 3. Installation ..... 13**

9145ELB Installation Procedures ..... 13
Unpacking ..... 13
Mounting Options ..... 14
Rack Mounting ..... 14
Mounting the 9145ELB in a 19" or 23" Rack ..... 14
Horizontal Flat Surface Mounting ..... 15
Installing the SFP Module ..... 15
Installing the Fan Module ..... 16
Installing a Power Supply Module ..... 17
Installing the Network Port Module ..... 17
Connecting the Electrical Power ..... 18
AC Power ..... 18
DC Power ..... 18
Grounding ..... 19
Connecting the Fiber Optic and UTP Ethernet Cables ..... 20
Optical Fiber Cable Installation ..... 20
UTP Cable Installation ..... 20

**Chapter 4. Operation ..... 21**

Power-Up and Front Panel Functions ..... 21
Port Default Settings ..... 22
LED Indicators ..... 23
Management Section LEDs ..... 23
Data Interface Section LEDs ..... 24
Interface Management ..... 25

Setting Up the VT-100 Terminal ..... 25

**Chapter 5. Troubleshooting ..... 27**

Optical Power Loss ..... 27

Fault Conditions ..... 27

Remote Fault ..... 27

Link Loss Forwarding ..... 28

Running Diagnostics ..... 29

PING Testing ..... 29

Loopback Diagnostics ..... 29

Troubleshooting the Dual 10G Optical Ethernet Module ..... 29

**Chapter 6. Maintenance ..... 31**

General Maintenance ..... 31

Checking Optical Power Levels ..... 31

Measuring Transmitter Output Power ..... 31

Measuring Receiver Input Power ..... 32

Calculating Fiber Link Attenuation ..... 33

Replacing a Network Port Module ..... 34

Replacing the Fan Module ..... 34

Replacing a Power Supply Module ..... 35

# Chapter 1

# Introduction

## 1.1 Product Description

Canoga Perkins 9145ELB Multi-Port 10 Gigabit Network Interface Device (NID) is equipped with 16 User Ports and an interchangeable Network Interface Module supporting SONET/SDH and 10 Gigabit Ethernet Ports. It is typically installed in customer premises at the user network interface (UNI) to provide demarcation between the customer and the service provider network. In addition to providing a clear demarcation, the 9145ELB is an intelligent NID equipped with a set of Operation Administration and Maintenance (OAM) and Layer 2 functions that allow service providers to operate and maintain network elements remotely and cost effectively.

The 9145ELB placed at the UNI or Network-to-Network Interface (NNI) can terminate all types of Ethernet services defined in MEF 6.1, including Ethernet Private Line (EPL), Ethernet Virtual Private Line (EVPL), Ethernet Private LAN (EP-LAN), Ethernet Virtual Private LAN (EVP-LAN), Ethernet Private Tree (EP-Tree) and Ethernet Virtual Private Tree (EVP-Tree).

The 9145ELB features a field-installable Network Port module that allows encapsulation of customer Ethernet frames for delivery over PDH, SONET, and native Ethernet over fiber.

---

**NOTE:** Safety warnings appear throughout this publication in procedures that may harm you if performed incorrectly. A warning symbol precedes each warning statement.

---

## 1.2 9145ELB Specifications

### 1.2.1 Physical Characteristics

- Dimensions: 1.75" H x 17.5" W x 10.5" D (44mm x 210mm x 290mm)
- Weight: 12 lb (2.7 kg)

### 1.2.2 Environmental Characteristics

- Operating Temperature: 0°to +50°C (32 to 122°F )
- Operating Humidity: 5-90% Relative Humidity (non-condensing)

### 1.2.3 Power Requirements

- AC Power Supply: 100 VAC to 240 VAC, 50 to 60 Hz, Auto Ranging, 120W

- DC Power Supply: 36 VDC to 72 VDC, 120W

### 1.2.4 Regulatory Compliance

- ETL, cETL (UL 60950, CAN/CSA C22.2 No. 60950) EN 60950
- EN 60825-1, IEC 60825-1
- EN 55022, EN 55024, EN 61000-3-2, EN 61000-3-3 (Pending)
- FCC Part 15B, Class A, ICES-003 Class A
- C-Tick (AS/NZS 3548)
- NEBS Level 3 (Pending)
- CE Mark (Pending)

### 1.2.5 Mounting Options

- 19-Inch or 23-Inch single-unit rack mount
- Table Top

See Chapter 3, "Installation" on page 13, for installation procedures.

### 1.2.6 Rack Mounting

Customers must order the brackets required () for their particular rack installation.

For rack mounting installation instructions, see "Rack Mounting" on page 14.

## 1.3 Terminology

The following terms and acronyms are used in this manual.

| Term | Description |
|---|---|
| BIDI | Bidirectional SFP |
| CEN | Carrier Ethernet Network |
| CFM | Connectivity Fault Management |
| CoS | Class of Service |
| CRC | Cyclic Redundancy Check |
| FPGA | Field Programmable Gate Array |
| LAG | Link Aggregation Group |
| LCAS | Link Capacity Adjustment Scheme |
| MEN | Metro Ethernet Network |
| MP | Maintenance Point |

| | |
|---|---|
| NID | Network Interface Device |
| NNI | Network-to-Network Interface |
| NPA | Network Performance Assurance |
| OAM | Operation, Administration and Maintenance |
| OOB | Out of Band |
| POST | Power On Self Test (Runs each time power is turn on or cycled) |
| QoS | Quality of Service |
| RJ45 | Registered Jack 45 |
| SFP | Small Form Factor Pluggable (fiber optic module with LC connectors) |
| SOAM | Service OAM |
| SPD | Speed |
| STP | Shielded Twisted Pair |
| UTP | Unshielded twisted pair |
| VCAT | Virtual Concatenation |
| VCG | Virtual Concatenation Group |

# Chapter 2

# Functional Description

## 2.1 9145ELB Base Unit

All 9145ELB data and management ports and connectors are accessible from the front panel. All modules, that is, the Network Port modules, fan and power modules, are hot swappable. A grounding lug is located on the back panel.

Three base unit models are available:

- 16 RJ45 (UTP) User Ports
- 16 SFP User Ports
- 8 RJ45 (UTP) plus 8 SFP User Ports

The 9145ELB is available with AC and DC power options.

All models accommodate feature enhancements through firmware upgrades.

### 2.1.1 9145ELB Model Numbers

- 9145ELB base unit model numbers and configurations are described in Table 2-1.
- Network port module, fan, and power supply model numbers are described in Table 2-2.
- For a detailed list of SFP model numbers, contact Canoga Perkins Support.

***Figure 2-1 Model number 9145ELB-B81-M-0***

***Figure 2-2 Model number 9145ELB-B82-M-0***

*Figure 2-3 Model number 9145ELB-B83-M-0*

*Table 2-1 9145ELB Base Unit Model Numbers and Configuration*

| Model Number | Extended Description |
|---|---|
| 9145ELB-B81-M-0 | 9145ELB, 16 User Ports, Local Ethernet Management Port, Console Port, Requires: Fan Module, Power Supplies, and Network Port Module. |
| 9145ELB-B82-M-0 | 9145ELB, 16 SFP User Ports, Local Ethernet Management Port, Console Port, Requires: Fan Module, Power Supplies, and Network Port Module. |
| 9145ELB-B83-M-0 | 9145ELB, 8 User Ports and 8 SFP User Ports, Local Ethernet Management Port, Console Port, Requires: Fan Module, Power Supplies, and Network Port Module. |

*Table 2-2 9145ELB Module Numbers*

| Model Number | Description |
|---|---|
| 9420-00 | Fan Module |
| 9420-04 | AC power supply |
| 9420-05 | -48V DC power supply |
| 9420-06 | -24V DC power supply |
| 9420-302 | Dual 10G Optical Ethernet Module |

## 2.2 Front Panel

The 9145ELB front panel is shown in Figure 2-4. The User Ports, located on the left, consist of sixteen dual media ports. The Network Ports feature a field replaceable card that can accommodate different types of uplinks.

All 9145ELB ports and connectors are accessible from the front panel. All front panel modules (Network Port modules, fan and power modules) are hot swappable.

The 9145ELB front panel has the following features:

- Sixteen dual media User Ports with SFP and RJ45 connectors. See the section "User Ports" on page 7.
- Dual 10G Optical Ethernet Network Port module. See the section "Dual 10G Optical Ethernet Module" on page 8.

- One Ethernet Management port with RJ45 connectors. See the section "Ethernet Management Port" on page 8.
- One console port with 8-pin modular connector. See the section "Console Port and Management Interface" on page 8.
- Two hot wappable power supply slots. See the section "Powering" on page 11.
- A hot swappable fan module slot. See the section "Fan Module" on page 10.
- Power and status LEDs. See the section "LED Indicators" on page 23.
- Reset button. See the section "Reset Button" on page 12.

***Figure 2-4 Front Panel***

## 2.2.1 User Ports

The sixteen 9145ELB User Ports are shown in Figure 2-4.

- RJ45 connectors are IEEE 802.3 compliant for 10/100/1000BASE-T.
- RJ45 connectors support MDI and MDIX connections.
- RJ45 connectors support both full-duplex and half-duplex operation in 10/100/1000 Mbps mode.
- SFP modules support full-duplex operation at 100/1000 Mbps.

## 2.2.2 Network Port Modules

The 9145ELB features a hot swappable Dual 10G Optical Ethernet Network Port module.

### *2.2.2.1 Dual 10G Optical Ethernet Module*

The Dual 10G Optical Ethernet Module (Figure 2-5) has two SFP+ ports, 10G1 and 10G2. The SFP+ interfaces support link aggregation and can join the same link aggregation group (LAG).

***Figure 2-5 Dual 10G Optical Ethernet Module***

## 2.2.3 Ethernet Management Port

An RJ45 Management port is used for management of the 9145ELB. The management port is equipped with an MDI and MDIX feature that allows automatic detection cross-over of Tx and Rx pairs.

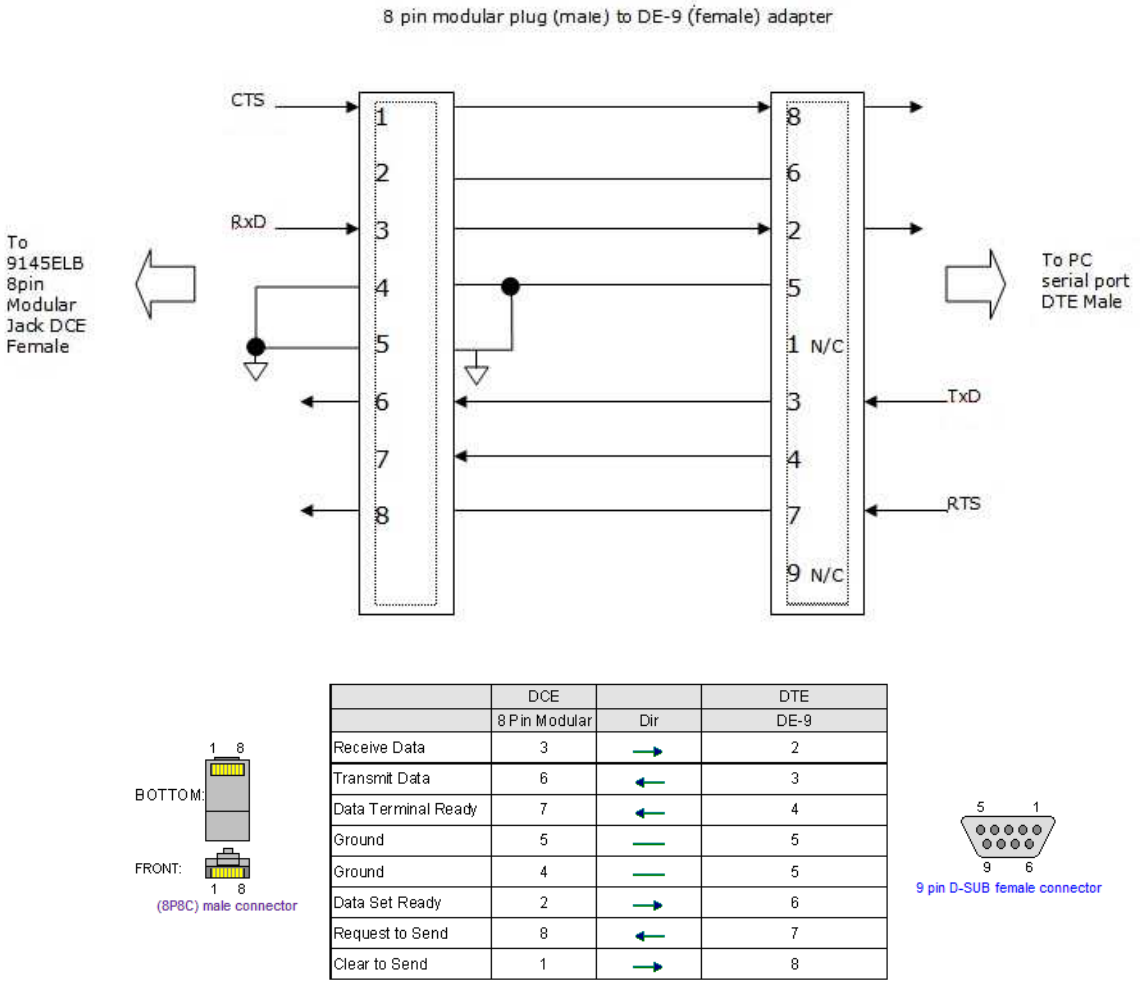
The RJ45 port is IEEE 802.3 compliant for 10BASE-T and 100BASE-TX and supports 10 Auto and 100 Auto modes of operation.

## 2.2.4 Console Port and Management Interface

The console port is used for communication between the 9145ELB and a VT100 terminal or emulator.

The console port is an 8-pin modular jack (Figure 2-6) that connects to the terminal with a cable adapter which can be purchased with the 9145ELB. The console port of the 9145ELB is used for serial communication between the NID and a VT100 terminal or emulator.

The console port terminates on an 8-pin modular jack, with a DCE pin-out as per "Cisco blue cable".




| | DCE | | DTE |
|---|---|---|---|
| | 8 Pin Modular | Dir | DE-9 |
| Receive Data | 3 | → | 2 |
| Transmit Data | 6 | ← | 3 |
| Data Terminal Ready | 7 | ← | 4 |
| Ground | 5 | — | 5 |
| Ground | 4 | — | 5 |
| Data Set Ready | 2 | → | 6 |
| Request to Send | 8 | ← | 7 |
| Clear to Send | 1 | → | 8 |

***Figure 2-6 Console Port Pinouts***

### 2.2.5 Fan Module

A hot swappable fan module is located on the front right of the 9145ELB base unit. The fan exhaust is located on the right side of the base unit. Air intake vents are located on the left side. The 9145ELB will remain within normal operating temperature for a maximum of 1 minute while the fan tray is swapped by a field technician.

***Figure 2-7 Fan Module***

## 2.2.6 Powering

The 9145ELB has two power supply slots that can accommodate any of the following power supply modules:

- AC Power Supply Module
- 48VDC Power Supply Module
- 24VDC Power Supply Module

All power supply modules are field replaceable and hot swappable.

### *2.2.6.1 AC Power Supply Module*

The AC Power Supply Module has an IEC 320 power inlet on the front face. The AC power cord is supplied with the unit.

***Figure 2-8 AC Power Supply Module***

### *2.2.6.2 48 VDC Power Supply Module*

The DC Power Supply Module is equipped with a three terminal receptacle on the front panel. A DC terminal block is supplied with the unit.

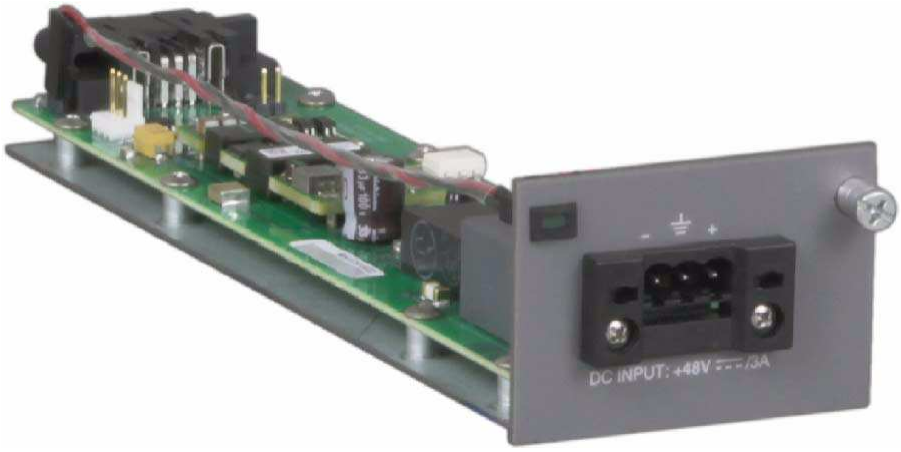



***Figure 2-9 48 VDC Power Supply Module***

### *2.2.6.3 24 VDC Power Supply Module*

The 24 VDC Power Supply Module is equipped with a three terminal receptacle on the front panel. A DC terminal block is supplied with the unit.

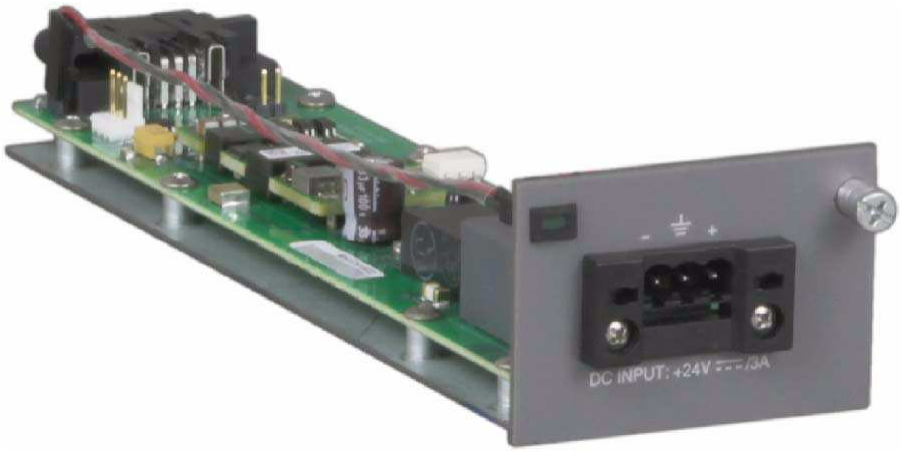



***Figure 2-10 24 VDC Power Supply Module***

## 2.2.7 Reset Button

Reset can be initiated from the front panel reset button or from a terminal-console port session. Reset can be used to initiate file downloads and other software functions such as clearing certain logs. During normal operation pressing this button will not affect user traffic. Telnet, terminal, and other management sessions using the OOB or the console will be temporarily disconnected and re-login will be required.

# Chapter 3

# Installation

## 3.1 9145ELB Installation Procedures

This section describes how to unpack, install, and set up the 9145ELB. Before set up, ensure that an 8-pin cable is available to connect the 9145ELB's console port to a VT100 type terminal or PC for setup and configuration.

Keep the shipping container and all packing materials until the unit is installed and fully operational. In the event that the unit needs to be returned, contact Canoga Perkins Customer Service for a Return Authorization Number (RMA) and instructions for return shipment.

**CAUTION:** Follow electrostatic discharge (ESD) safety precautions when handling Canoga Perkins products, as with all electronic devices with static sensitive components.

## 3.2 Unpacking

1. Open the shipping container, remove the accessories tray, and remove the accessories from the tray.
2. Lift the 9145ELB out of the shipping container.
3. Return all packing materials to the shipping container and put it in a safe place in the event the unit needs to be returned.

**NOTE:** This equipment must be installed in restricted access areas such as dedicated equipment room, or electrical closet, in accordance with Articles 110-18, 110-26 and 110-27 of the 1999 United States National Electrical Code ANSI/NFPA 70.

## 3.3 Mounting Options

The 9145ELB can be rack mounted or placed on any horizontal flat surface such as a shelf or table.

### 3.3.1 Rack Mounting

One 9145ELB can be mounted in  a 19" rack or a 23" rack.

Rack mounting kits (Table 3-1) are available. Each rack mount kit contains the brackets necessary for installing the 9145ELB (Figure 3-1), as well as the mounting hardware required to attach the brackets to the unit(s). Rack mount screws are provided by the rack manufacturer.

***Table 3-1  Rack Mount Kits***

| Rack Mount Kit | Part Number | Component | Part Number | Qty |
|---|---|---|---|---|
| Rack Mount Bracket Kit, 19" Single Unit | 1803-2000 | Bracket, rack mount,single, 19” | 6214100-119-6 | 2 |
| | | Screw, 8-32 flat head, 5/16 L | 8060051 | 8 |
| Rack Mount Bracket Kit, 23" Single Unit | 1803-2001 | Bracket, rack mount,single, 23” | 6214100-123-6 | 2 |
| | | Screw, 8-32 flat head, 5/16 L | 8060051 | 8 |

***Figure 3-1  9145ELB Rack Mounting Brackets***

#### *3.3.1.1 Mounting the 9145ELB in a 19" or 23" Rack*

To rack mount one 9145ELB, use the following steps:

1. Install the 19" or 23" Rack Mount Bracket Kit.

   The Rack Mount Kit includes two mounting brackets and the screws required to attach the brackets to the 9145ELB. The brackets attach to the four threaded holes on each side of the 9145ELB, toward the front (Figure 3-2) using the flat head screws provided.

   Torque the flat head screws to 14.5 – 15.5 in-lb.
2. Place the unit with brackets attached in place on the mounting rack.
3. Install four screws through each bracket into the threaded holes on the mounting rackFigure 3-2. Torque the screws to the rack manufacturer's specifications.

***Figure 3-2 Installing the Rack Mount Kit***

### 3.3.2 Horizontal Flat Surface Mounting

The 9145ELB requires at least one inch of unobstructed space around the perimeter for ventilation. Canoga Perkins recommends a space of 3 to 5 inches be left unobstructed to allow for SFP module access, cable access, and power connections.

To install the 9145ELB on a flat surface, place the 9145ELB on a secure flat surface such as a table, a shelf, or a desk within reach of the power and fiber optic cables.

Connect the power and fiber optic cables to the 9145ELB as required.

## 3.4 Installing the SFP Module

Follow these steps to install the SFP module:

1. Determine which SFP Module(s) is/are required for the user and Network Ports by referencing the SFP Product Data Sheet.
2. Insert a module into each available port and push firmly to seat the module (Figure 3-3).
3. Raise the latch to lock the module in place.

***Figure 3-3 SFP Modules***

## 3.5 Installing the Fan Module

Follow these steps to install the fan module (Figure 3-4):

1. Remove the fan module from its packaging.
2. Carefully insert the replacement fan module into the slot, being sure to align the module so it slides along the guide rails and mates securely with the backplane.
3. Screw in the thumb screw to secure the fan module to the enclosure.

***Figure 3-4 Fan Module - Front View***

## 3.6 Installing a Power Supply Module

Follow these steps to install the power supply module (Figure 3-5):

1. Remove the power supply module from its packaging.
2. Carefully insert the module into the slot, being sure to align the module so it slides along the guide rails and mates securely with the backplane.
3. Screw in the thumb screw to secure the power supply module to the enclosure.

***Figure 3-5 Power Supply Module***

## 3.7 Installing the Network Port Module

Follow these steps to install a Network Port module:

1. Align the module with the rails on either side of the Network Port.
2. Slide the module into the Network Port.
3. Insert and tighten the screws in the chassis.

If no module is installed, the serial port UI will indicate an error condition. You will be prompted to power down the unit and install a plug-in Network module before powering up again. Opening a Telnet session will display the same error condition. FTP and SNMP will not function if the Network Port module is not installed.

## 3.8 Connecting the Electrical Power

When power is applied, all LED indicators will light amber.

### 3.8.1 AC Power

The 9145ELB uses a standard IEC320 AC Power Connector with C13/C14 couplers. Plug the AC power cord into the socket at the front of the 9145ELB and plug the other end of the AC power cord into a convenient AC outlet.

### 3.8.2 DC Power

The DC Power Terminal Block (Figure 3-6) is removable for ease of installation and replacement. We recommend that you remove the Terminal Block from the power supply module when you connect the power leads to avoid damaging the 9145ELB or your DC power source.

**CAUTION:** The wire leads must be disconnected from the power source before starting.

**CAUTION:** The DC 9145ELB is only intended to be used in a restricted access location in accordance with Articles 110-16, 110-17, and 110-18 of the National Electric Code ANSI/NFPA 70.

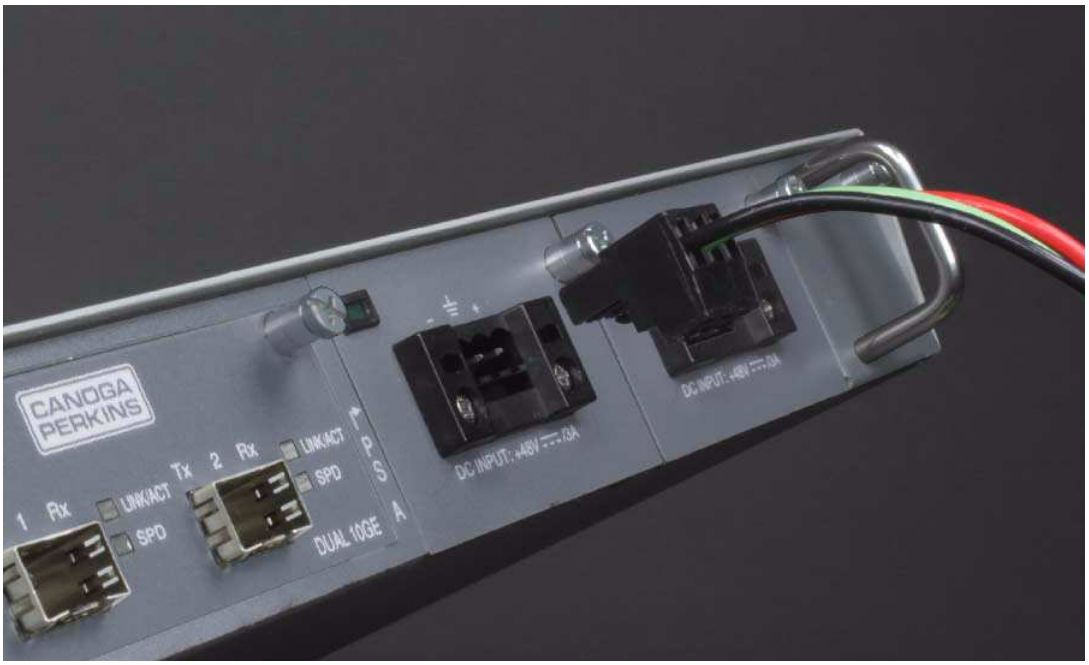



***Figure 3-6 Terminal Block, Terminal Block Connector, and Power Leads***

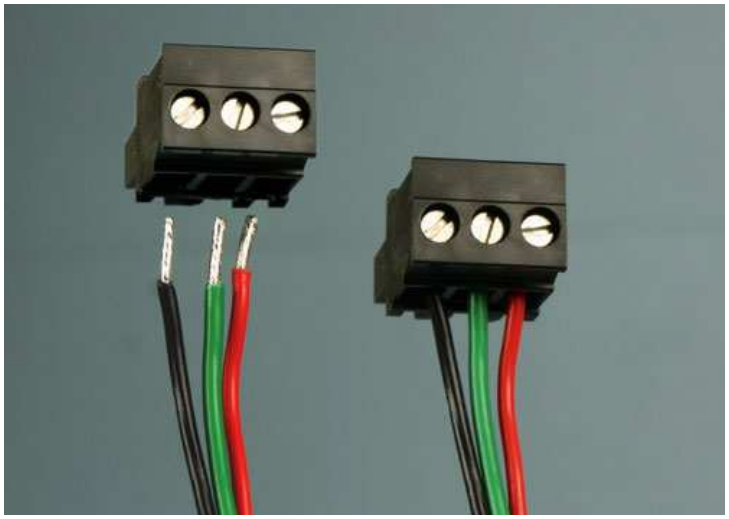


***Figure 3-7 DC Power Leads***

The 9145ELB is shipped with a compatible DC Power terminal block. To connect DC power to the 9145ELB:

**NOTE:** The 9145ELB supports both Positive and Negative grounded DC power.

1. Loosen the terminal screws for +, -, and GND.
2. Slide the wires one at a time (green = GND, red = +, black = -) into the square openings in the bottom of the terminal block.
3. Tighten the terminal screws so that they crimp the wires.
4. Use an ohmmeter to verify that power leads are not shorted to GND.
5. Connect the **+** and **-** wires to the power source.
6. Insert the terminal block into the DC power receptacle at the front of the 9145ELB.

### 3.8.3 Grounding

A grounding lug kit is included in the 9145ELB accessory tray. Connect a 6AWG grounding cable to the 9145ELB as follows (Figure 3-8):

1. Strip approximately ¾-inch of insulation from the end of the grounding cable.
2. Twist the exposed wires together and trim the ends off evenly.
3. Insert exposed wire into the grounding lug until it bottoms out inside the barrel.
4. Position the crimping tool over the center of the grounding lug, with the lug in the crimping tool's proper crimp pocket.
5. Squeeze handles firmly until grounding wire is secured within the grounding lug.
6. Insulate the grounding connection as required.

7. Align the screw holes in the grounding lug with the mounting holes at the center of the back of the 9145ELB.
8. Install the two screws included with the grounding lug kit. Torque the screws to 14.5 – 15.5 in-lb.

***Figure 3-8 Install Grounding Lug***

## 3.8.4 Connecting the Fiber Optic and UTP Ethernet Cables

### *3.8.4.1 Optical Fiber Cable Installation*

**NOTE:** To avoid damaging the fiber end-surface or connector, use extreme care when installing or removing cables.

Connect the Optical Fiber cables to the SFP modules as follows:

1. Plug in the optical cables with proper Tx-to-Rx or Rx -to-Tx orientation.
2. Ensure connector locks in place.
3. Label each cable with the signal direction (Tx or Rx).

### *3.8.4.2 UTP Cable Installation*

Connect the UTP cables to the RJ45 connectors as follows:

1. Plug the UTP Cable into the RJ45 connector.
2. Be sure the locking tab is properly seated.

# Chapter 4

# Operation

## 4.1 Power-Up and Front Panel Functions

The LEDs on the front panel indicate the system and port status of the 9145ELB. During power-up, all LEDs on the 9145ELB will light amber. When power-up has been completed, the LEDs will display status as described in the following paragraphs. For Port locations, see Figure 2-4.

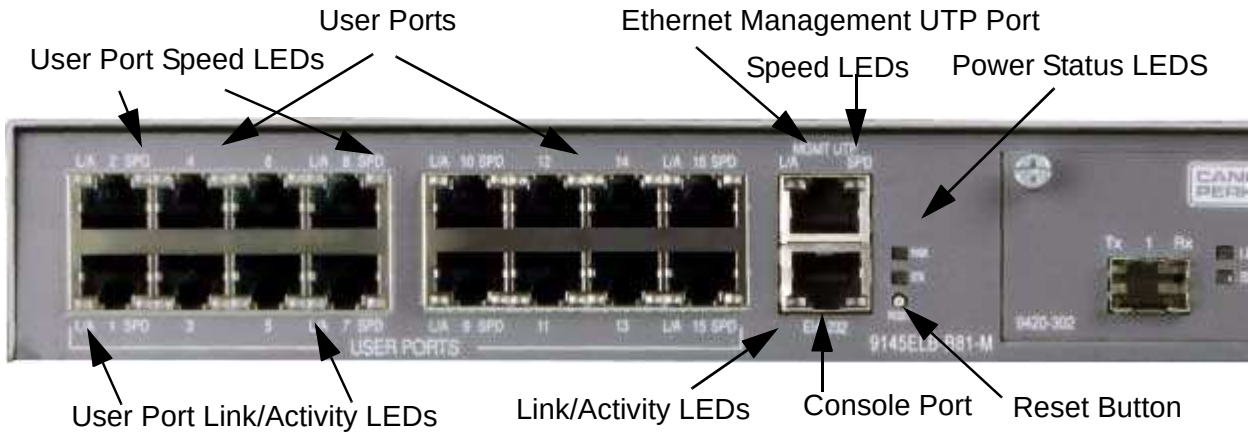



***Figure 4-1 Front panel (left side)***

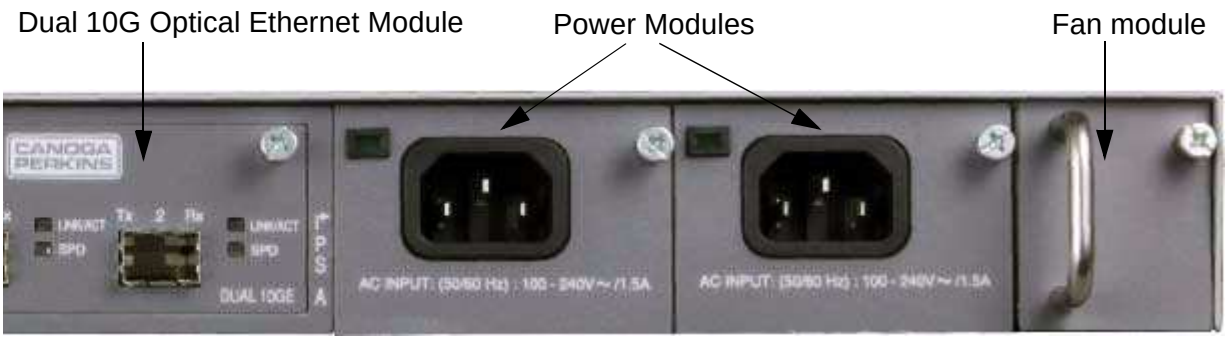



***Figure 4-2 Front panel (right side)***

Additional information about fault conditions appears in the System Alarms and System Status and Configuration screens (see the *9145ELB NID Software User's Manual)*.

The power and status LEDs, located to the right of the EIA-232 console port, indicate condition and state of the 9145ELB. The meaning of the power and status lights is described in Chapter 2, "Functional Description" .

- Table 4-1. describes the default port settings.
- Table 4-2. describes the Ethernet Management LEDS.
- Table 4-3. describes the LED indicators for User Ports.
- Table 4-4. describes the LED indicators for Network Ports.

## 4.2 Port Default Settings

Table 4-1. lists the default settings for each port.

***Table 4-1. Default Port Settings***

| Module | Active Connector | Rate/Speed |
|---|---|---|
| User Ports 1-8 | RJ45 | Autonegotiate |
| User Ports 9-16 | SFP/Duplex LC | 100M or 1000M FD |
| Dual 10G Optical Ethernet Module | SFP+/Duplex LC | 10G FD |

- When a 100 Mbps SFP/fiber optic User Port is made active, the default setting is 100M Full Duplex.
- When a 1000 Mbps SFP/fiber optic User Port is made active, the default setting is 1000M Full Duplex.
- When a Multi-rate SFP/fiber optic User Port is made active, the default setting is 1000M Full Duplex.

## 4.3 LED Indicators

The following sections describe the functions of the LED indicators on the 9145ELB front panel.

### 4.3.1 Management Section LEDs

The Link/Activity (LNK/ACT) front panel LED, located to the right of the MGMT UTP Port, indicates the presence of transmit or receive activity. The Speed (SPD) front panel LED, located directly below the LINK/ACT LED, indicates the speed of the transmissions.

***Table 4-2. Ethernet Management, Status, and Power LED Indicators***

| LED Name | LED State | Condition |
|---|---|---|
| Speed (SPD) | Off | 10 Mbps |
| | | Auto negotiate or no link |
| | | Port disabled |
| | Amber | 100 Mbps |
| | | System is booting |
| | Slow Blinking Green* | Port enabled but no link |
| Link/Activity (ACT) | Off | No link |
| | | No transmit or receive activity |
| | Green | Link on with full duplex |
| | Blinking Green | Transmission or receiving activity with full duplex |
| | Amber | System is booting |
| | | Link on with half duplex |
| | Blinking Amber | Transmission or receiving activity with half duplex |
| * Slow blinking green means LED toggles between Off and Green approximately. once per second. | | |
| Status | Off | No power |
| | Green | Normal operation |
| | Amber | System self-test in progress |
| | Blinking Amber | System is booting |
| | Red | Major alarms including link loss at any user or Network Port |
| | Blinking Red | Critical alarms requiring immediate user intervention, e.g., the failure of one of the redundant power supplies, temperature or voltage out of range alarms, or a fan failure |

| LED Name | LED State | Condition |
|---|---|---|
| Power (PWR) | Off | Power is off |
| | Green | Power is on |
| | Amber | One power supply failed in a redundant power supply configuration |
| | Red | One of the board supply voltages has exceeded a threshold value |

## 4.3.2 Data Interface Section LEDs

Table 4-3. describes the LED indicators for the SPD and ACT LEDs of User Ports. Table 4-4. describes the LED indicators for Network Ports. Indications apply to both the SFP and UTP LEDs.

***Table 4-3. User Port LED Indicators***

| LED Name | State | Condition |
|---|---|---|
| Speed (SPD) | Off | 10 Mbps (Copper or Twisted Pair Links only) |
| | | Auto negotiate |
| | | Port disabled |
| | Green | 1000 Mbps |
| | Amber | 100 Mbps |
| | | System Test |
| | Slow Blinking Green* | Port enabled but no link |
| | Red | Remote fault (fiber optic links only) |
| | Blinking Red | Invalid/unsupported SFP installed (SFP connectors only) |
| Link Activity (LA) | Off | No link |
| | | No transmit or receive activity |
| | | Port disabled |
| | Green | Link up with full duplex |
| | Blinking Green | Transmit or receive activity in full duplex |
| | Amber | System test |
| | | Link up with half duplex |
| | Blinking Amber | Transmit or receive activity in half duplex |
| | | Link down but transmitting OAM packets in unidirectional mode (UTP connectors only) |
| | Blinking Red | Link down but transmitting OAM packets in unidirectional mode (SFP connectors only) |
| * Slow blinking green means that the LED toggles between Off and Green approximately once per second | | |

***Table 4-4. Network Port LED Indicators (SFP and Dual 10G Optical Ethernet Module)***

| LED Name | State | Condition |
|---|---|---|
| Speed (SPD) | Off | Port Disabled |
| | | Autonegotiate |
| | Green | 1000 Mbps |
| | Amber | 100 Mbps |
| | | System test |
| | Slow Blinking Green* | Port enabled but no link |
| | Red | Remote fault |
| | Blinking Red | Invalid/unsupported SFP installed |
| Link Activity (LA) | Off | No link |
| | | No transmit or receive activity |
| | | Port disabled |
| | Green | Link up with full duplex |
| | Blinking Green | Transmit or receive activity in full duplex |
| | Amber | System test |
| | | Link up with half duplex |
| | Blinking Amber | Transmit or receive activity in half duplex |
| | Blinking Red | Link down but transmitting OAM packets in unidirectional mode |
| * Slow blinking green means that the LED toggles between Off and Green approximately once per second. | | |

## 4.4 Interface Management

The 9145ELB is managed locally through the console port and remotely either through the Management UTP port or inband via the Network Ports. The console port is connected to a VT-100 terminal, through an emulation program, through the serial port using a RJ45 UTP cable. OOB is an out-of-band 10/100 Mbps port supporting Telnet, SSH, and SNMP V1/V2C/V3 used for network management.

## 4.5 Setting Up the VT-100 Terminal

When using the console port, you can use the HyperTerminal Emulation program that is included with your Microsoft Windows operating systems. The Telnet session is only available after the management TCP/IP configuration is completed.

**NOTE:** The Microsoft Vista operating system does not include HyperTerminal. If your terminal interface computer uses Windows Vista, you will need to use a different terminal emulation program.

The following steps describe how to set up HyperTerminal on your PC.

1. Select **Start > All Programs > Accessories > Communications > HyperTerminal**. A New Connection - HyperTerminal window will open.
2. Enter a name for the connection to the system in the Name box and select an icon to identify this connection on your desktop. Click **OK**. The **Connect To** window opens.
3. Select **COM** from the Connect using drop down menu, and click **OK**. The Com1 Properties window will open.
4. At the COM 1 Properties window, on the Port Settings tab, select the following from the appropriate dropdown menus and then click **Apply**:
    - **Bits per second**: 9600 bps
    - **Data bits**: 8
    - **Parity**: None
    - **Stop bits**: 1
    - **Flow control**: None
5. Click **OK**. HyperTerminal connects to the system and VT100 terminal emulation starts.
6. In the Hyperterminal window toolbar, click the **Properties** button, then select the **Settings** tab. From the Emulation drop down menu, select VT100 and click **OK**.
    - The default username is admin.
    - The default password is admin (case sensitive).

# Chapter 5

# Troubleshooting

This chapter describes fault conditions and how to determine corrective action.

The front panel LEDs provide both normal and fault information. For a description of LED functions and indicators:

- For Ethernet Management, Status, and Power LEDs, see Table 4-2 on page 23
- For User Port LEDs, see Table 4-3 on page 24.
- For SFP and Dual 10G Optical Ethernet Module LEDs, see Figure 2-5

## 5.1 Optical Power Loss

Whenever there is a significant signal loss, the Rx indictor turns off. If this occurs, check the cable integrity, and remove and inspect the connectors, being careful not to damage the fiber end-face surface or the connector housing. Clean all optical connectors before reinstalling them.

## 5.2 Fault Conditions

The 9145ELB front panel and interface module LEDs show fault conditions. Additional information about fault conditions appears on the System Alarms Log. Use the System Alarms Screen to view alarms and faults on the 9145ELB.

For more details, see the *9145ELB NID Software User's Manual*.

### 5.2.1 Remote Fault

If an optical port loses the RX optical signal, it sends a Remote Fault (RMTF) signal on its Transmit to the distant end on the optical link. The SPD LED is off, and an alarm flags the link loss on the optical port. When an optical port receives a Remote Fault signal, the Link Activity (LA) LED lights red and an alarm flags the remote side optical link failure. Both local and remote link partners must be configured to the same RMTF enable/disable setting (Figure 5-1).

Remote fault occurs on an optical link only.

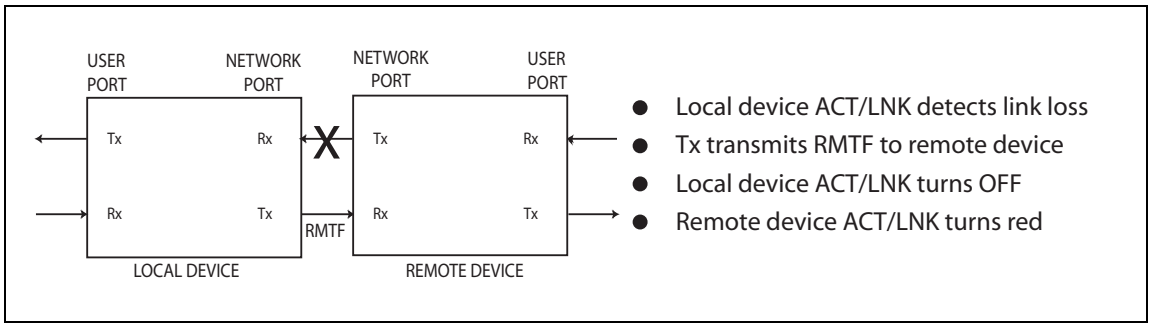



***Figure 5-1 Remote Fault Signal***

## 5.2.2 Link Loss Forwarding

When Link Loss Forwarding (LLF) is enabled, a fault on one side of the 9145ELB propagates to the other side to notify that device and stop signal transmission (Figure 5-2). Set the LLF propagation to User to Network, Network to User, or both directions.

For steps for configuring LLF, see the *9145ELB NID Software User's Manual*.

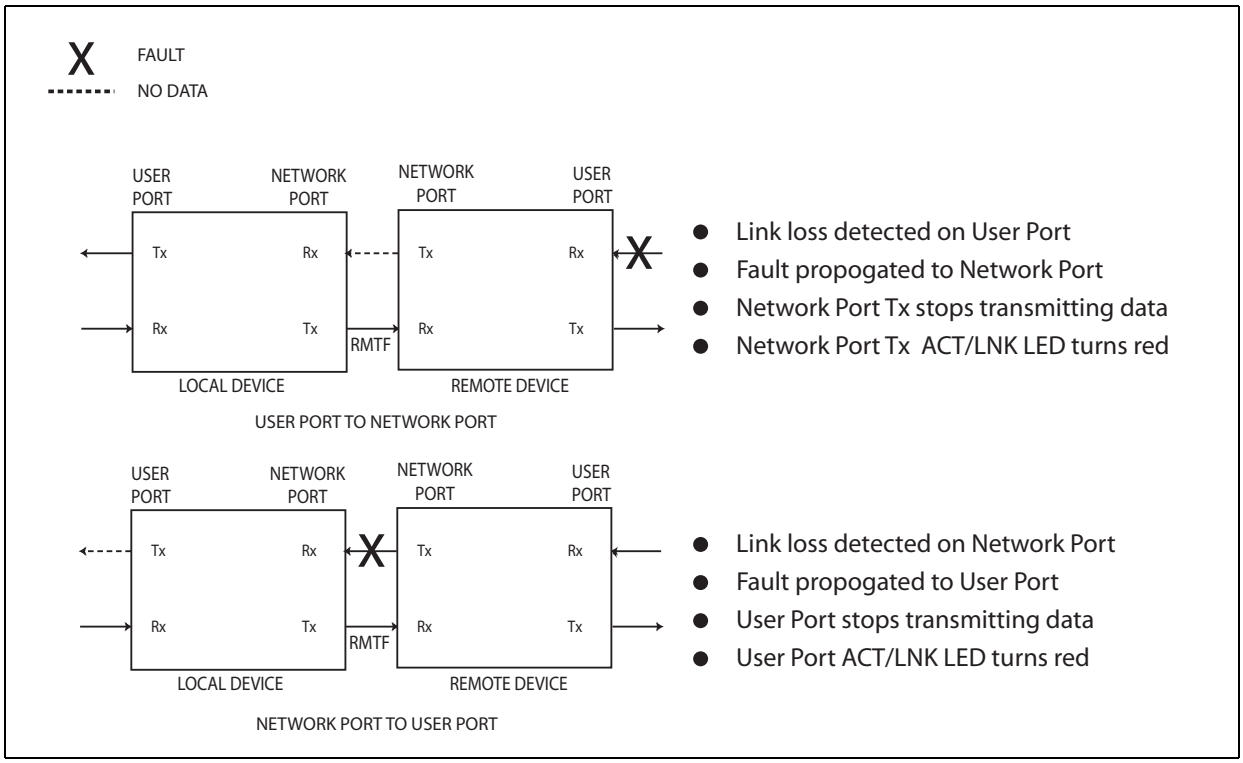



***Figure 5-2 Link Loss Forwarding***

## 5.3 Running Diagnostics

When you set up a new connection, you can verify the link connectivity using PING prior to sending data.

### 5.3.1 PING Testing

You can verify network connectivity with another IP device within the subnet by sending a PING to the IP address for that device. For PING testing instructions, see the *9145ELB NID Software User's Manual*.

## 5.4 Loopback Diagnostics

Use Loopbacks to diagnose a fault on the optical link. Loopbacks can be set at any port; once a port is in loopback mode, data is looped at the physical level though the particular port. When performing loopback diagnostics, the 9145ELB uses a unique MAC address, designated as the Loop Test MAC Address, which is displayed on the Loopback Setup Screen (see the *9145ELB NID Software User's Manual)*. When in loopback mode, the 9145ELB filters and discards all service frames. Only packets with the predefined Loop Test MAC Address are looped back.

The 9145ELB is configurable to swap the origination and destination MAC Addresses and to recalculate the looped frame's CRC. Test packets are returned to the source according to the selected options.

To display current loopback status, configure address swapping and CRC recalculation options, see the *9145ELB NID Software User's Manual*.

## 5.5 Troubleshooting the Dual 10G Optical Ethernet Module

This section describes some common LED-indicated states and provides troubleshooting action you can take.

The table identifies the most common troubleshooting situations for the Dual 10G Optical Ethernet Module.

| **L/A** | **SPD** | **State** | **Troubleshooting action** |
|---|---|---|---|
| Off | Off | Port disabled | Enable the port. |
| Amber | Amber | Unit is booting<br>or<br>interface card is not registered | Unit takes 15-20 seconds to boot.<br><br>Reset the unit: press the reset button or recycle the power. |
| Off | Red | Remote fault enabled | Check transmit on remote end. |
| Red | Off | Link loss forwarding | Check User Port link. |
| Blinking Green | Red | Tx down, Rx up | Check fiber for budget loss |

# Chapter 6

# Maintenance

## 6.1 General Maintenance

Well maintained components and clearly identified cables help assure optimum system operation. Damaged fiber optic cables and dirty connectors are a common source of signal loss or attenuation. Fiber optics are especially susceptible to contamination. Inspect, clean, and test all components to maintain optimum performance. Inspect the surface of the fiber optic ferrules and clean as required.

**CAUTION:** Follow electrostatic discharge (ESD) safety precautions when handling Canoga Perkins products, as with all electronic devices with static sensitive components.

**CAUTION:** To avoid damage and signal loss, do not over-tighten or force-fit optical connectors.

## 6.2 Checking Optical Power Levels

**NOTE:** For accurate results, warm up each unit for at least 30 minutes before checking power levels. Ensure the Transmit laser is turned on when the unit is powered up.

To ensure proper performance levels, measure Transmitter Output Power, Receiver Input Power, and attenuation for all fiber links. Each 9145ELB is shipped with a document that lists the output power for each optical transceiver.

### 6.2.1 Measuring Transmitter Output Power

To measure the output power:

1. Inspect and clean the connectors on a fiber optic test cable with a known loss, then connect it to the Tx connector on the 9145ELB.
2. Set the optical power meter to the proper wavelength.

3. Connect the other end of the optic test cable to the optical power meter (Figure 6-1), wait two or three minutes for the power reading to stabilize, and read the output power.
4. Add the test cable loss, then record the power level and compare it to the value on the performance sheet that was included for that transceiver. Measurement tolerance is +/- 0.5 dBm.
5. If the reading is low, repeat the measurement with a different test cable. If the power level is still not within range, call Canoga Perkins Technical Support.

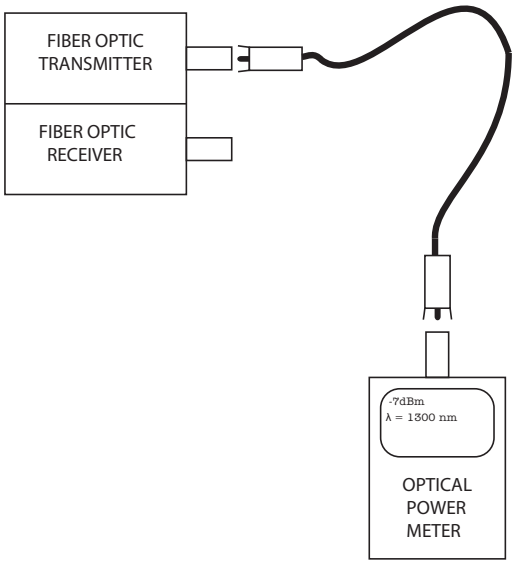



***Figure 6-1 Measuring Transmitter Output Power***

## 6.2.2 Measuring Receiver Input Power

To measure receiver input power (Figure 6-2):

1. Connect the transmit fiber to the transmit side of the equipment at the local site.
2. Connect a calibrated optical power meter to the end of the transmit fiber at the remote site.
3. Measure and record the optical power on the transmit fiber at the remote site. This is the receiver input power for the transmit fiber from the local site.
4. Connect the transmit fiber to the transmit side of the equipment at the remote site.
5. Connect a calibrated optical power meter to the end of the transmit fiber at the local site.
6. Measure and record the optical power on the transmit fiber at the local site. This is the receiver input power for the transmit fiber from the remote site.
7. Compare the receiver input power with the sensitivity level listed on the optical specifications sheet, located in the Client Support Area of the Canoga Perkins web site. The power level must be within the sensitivity range listed on the data sheet. If not, contact Canoga Perkins Technical Support.
8. Compare the receiver input power to the receiver's saturation (overdrive) level shown on the optical specifications sheet, located in the Client Support Area of the Canoga Perkins

web site. The power level must be lower than the saturation level. If not, contact Canoga Perkins Technical Support.

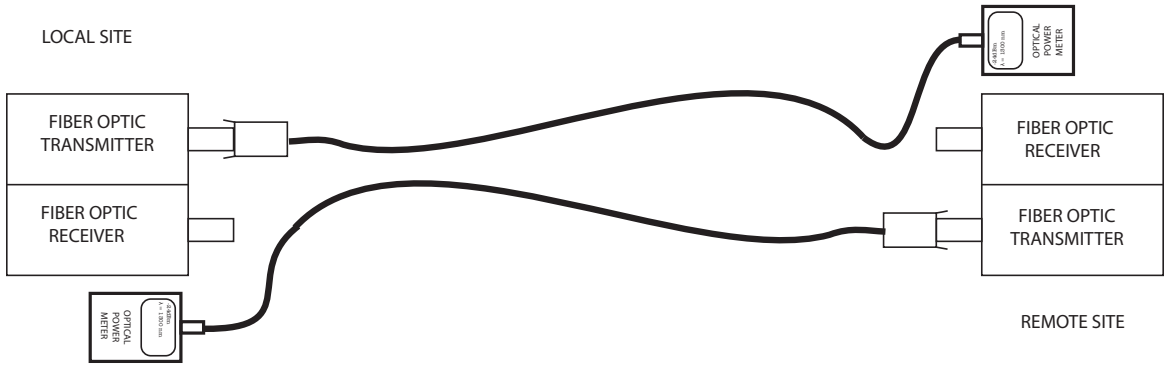



***Figure 6-2 Measuring Receiver Input Power***

## 6.2.3 Calculating Fiber Link Attenuation

Link attenuation measurement identifies potential problems with links that are on the threshold of receiver sensitivity. Measure optical fiber links at the shortest wavelength of operation, as it is the limiting factor in the loss budget. Use a power meter calibrated for the laser source, then factor in approximately 1 dB for the connector loss from the patch cables between the 9145ELB and the local device. (Each fiber connection can generate 0.5 dB of additional loss.)

If you cannot determine the Rx sensitivity, contact Canoga Perkins Technical Support for assistance.

Follow these steps to calculate fiber link attenuation:

1. Determine transmitter output power as described in section 6.2.1.
2. Determine receiver input power as described in section 6.2.2.
3. Subtract receiver input power from transmitter output power. The result is the fiber link attenuation.

| | |
|---|---|
| Transmit Output Power | -7.0 dBm |
| Receiver Sensitivity | -28.2 dBm |
| Fiber Link Attenuation | 21.2 dB |

## 6.3 Replacing a Network Port Module

**NOTE:** Installing and removing modules must be done by a service person.

Follow these steps to replace a Dual 10G Optical Ethernet Module:

1. Follow proper ESD procedures and ensure that you have grounded yourself to a common ground point in the equipment rack (i.e., through a wrist strap or other grounding device).
2. Loosen the thumb screws on the Dual 10G Optical Ethernet Module with your fingers or by using a Phillips screwdriver.
3. Carefully remove the module from the slot. The module should immediately be placed in an anti-static bag if it is going to be sent back to Canoga Perkins for repair.
4. Remove the replacement module from its packaging and anti-static bag.
5. Carefully insert the module into the Network Port module slot, being sure to align the module so it slides along the guide rails and mates securely with the backplane.
6. Screw in the thumb screw to secure the module to the enclosure.
7. Press the 9145ELB reset button on the front panel.

**NOTE:** Although the module is hot-swappable, the current 4.0 firmware does not support hot-swap capability. The system will need to be reset for the Manager to properly communicate with the new Network Port module.

## 6.4 Replacing the Fan Module

**CAUTION:** Do not allow the unit to be without a fan for longer than 1 minute. The unit will remain within normal operating temperature for 1 minute while the fan module is swapped by a field technician.

To replace a faulty fan module, follow these steps:

1. Follow proper ESD procedures and ensure that you have grounded yourself to a common ground point in the equipment rack (i.e., through a wrist strap or other grounding device).
2. Remove the replacement fan module from its packaging and set it aside.
3. On the 9145ELB, loosen the thumb screw on the fan module with your fingers or by using a Phillips screwdriver.
4. Carefully remove the fan module from the slot. The module should immediately be placed in an anti-static bag if it is going to be sent back to Canoga Perkins for repair.
5. Carefully insert the replacement fan module into the slot, being sure to align the module so it slides along the guide rails and mates securely with the backplane.
6. Screw in the thumb screw to secure the fan module to the enclosure.

## 6.5 Replacing a Power Supply Module

**CAUTION:** Unplug the power before removing power supply modules**.**

To replace a power supply module, follow these steps:

1. Follow proper ESD procedures and ensure that you have grounded yourself to a common ground point in the equipment rack (i.e., through a wrist strap or other grounding device).
2. Remove the terminal block (for DC models) or power cord (for AC models). Note that exposed power leads present a shock hazard.
3. Carefully remove the power supply module from the slot. The module should immediately be placed in an anti-static bag if it is going to be sent back to Canoga Perkins for repair.
4. Carefully insert the replacement power supply module into the slot, being sure to align the module so it slides along the guide rails and mates securely with the backplane.
5. Screw in the thumb screw to secure the module to the enclosure.
6. Reconnect the terminal block (for DC models) or the power cord (for AC models).

# CANOGA PERKINS CORPORATION

20600 Prairie Street
Chatsworth, California 91311-6008 USA
Phone: (818) 718-6300  FAX: (818) 718-6312
Web Site: www.canoga.com
Email: fiber@canoga.com